SCHOOL DISTRICT OF THE CHATHAMS

Creative Problem Solving
Grade 6
Marking Period

Course Overview

Using a variety of tools that will foster self-reflection and decision making, each student will be encouraged to take risks, make mistakes and imagine ideas to solve a variety of challenges. This exploration will allow individuals to advance skills, assist others by implementing their own strengths and grow a collaborative learning environment.

New Jersey Student Learning Standards
The New Jersey Student Learning Standards (NJSLS) can be located at www.nj.gov/education/cccs/2020/.

Engineering Design
8.2.8.ED.2: Identify the steps in the design process that could be used to solve a problem.
8.2.8.ED.3: Develop a proposal for a solution to a real-world problem that includes a model (e.g., physical prototype, graphical/technical sketch).
8.2.8.ED.4: Investigate a malfunctioning system, identify its impact, and explain the step-by-step process used to troubleshoot, evaluate, and test options to repair the product in a collaborative team.
8.2.8.ED.5: Explain the need for optimization in a design process.
8.2.8.ED.6: Analyze how trade-offs can impact the design of a product.
8.2.8.ED.7: Design a product to address a real-world problem and document the iterative design process, including decisions made as a result of specific constraints and trade-offs (e.g., annotated sketches).

Interaction of Technology & Humans
8.2.8.ITH.2: Compare how technologies have influenced society over time.
8.2.8.ITH.3: Evaluate the impact of sustainability on the development of a designed product or system.

Nature of Technology
8.2.8.NT.1: Examine a malfunctioning tool, product, or system and propose solutions to the problem.

Technology Standards
9.4.8.TL.5: Compare the process and effectiveness of synchronous collaboration and asynchronous collaboration.
9.4.8.TL.6: Collaborate to develop and publish work that provides perspectives on a real-world problem.

21st Century Integration | NJSLS 9
9.4.8.CI.3: Examine challenges that may exist in the adoption of new ideas (e.g., 2.1.8.SSH, 6.1.8.CivicsPD.2).
9.4.8.CI.4: Explore the role of creativity and innovation in career pathways and industries.

Career Ready Practices
CRP2. Apply appropriate academic and technical skills.
CRP4. Communicate clearly and effectively and with reason.

CRP6. Demonstrate creativity and innovation
CRP8. Utilize critical thinking to make sense of problems and persevere in solving them.
CRP11. Use technology to enhance productivity.

Interdisciplinary Connections

Comprehensive Health & Physical Education

- 2.1.8.SSH.3: Demonstrate communication skills that will support healthy relationships.

Science

- MS-ETS1-1. Define the criteria and constraints of a design problem with sufficient precision to ensure a successful solution, taking into account relevant scientific principles and potential impacts on people and the natural environment that may limit possible solutions.
- MS-ETS1-2. Evaluate competing design solutions using a systematic process to determine how well they meet the criteria and constraints of the problem.
- MS-ETS1-3. Analyze data from tests to determine similarities and differences among several design solutions to identify the best characteristics of each that can be combined into a new solution to better meet the criteria for success.
- MS-ETS1-4. Develop a model to generate data for iterative testing and modification of a proposed object, tool, or process such that an optimal design can be achieved.

ELA

- RST.6-8.1 Cite specific textual evidence to support analysis of science and technical texts
- WHST.6-8 Gather relevant information from multiple print and digital sources, using search terms effectively; assess the credibility and accuracy of each source; and quote or paraphrase the data and conclusions of others while avoiding plagiarism and following a standard format for citation
- WHST.6-8.7 Conduct short research projects to answer a question (including a self-generated question), drawing on several sources and generating additional related, focused questions that allow for multiple avenues of exploration

Mathematics

- MP.2 Reason abstractly and quantitatively
- 7.EE.3 Solve multi-step real-life and mathematical problems posed with positive and negative rational numbers in any form (whole numbers, fractions, and decimals), using tools strategically. Apply properties of operations to calculate with numbers in any form; convert between forms as appropriate; and assess the reasonableness of answers using mental computation and estimation strategies.

Units of Study

Unit 1: iSTEM & the Design Process (~15 days)

- What is the difference between science and technology, and how are they related?
- If technology and the nature of technological problems are continuously evolving, why is it so important to understand science, technology and engineering design in the present day?
- What processes help designers and engineers develop organized and successful solutions to technological problems?
- Why is the engineering design process modeled as a loop, not linearly?

Unit 2: Engineering Design Applications (~25 days)

- What are the various problem solving processes? What are their similarities and differences?
- What do I already know that can help me/my group with developing a solution to the problem at hand?
- What else do I/we need to know in order to develop a solution to the problem at hand?

- Who am I designing for (target audience) and how do I ensure my design meets the wants and needs of the target audience?
- How can I use the materials and time provided, as well as our prior knowledge and new knowledge to solve the problem at hand?
- How do I clearly communicate the attributes of my/our design to others to aid in the manufacturing/production process?
- Of all the possible designs, which one best solves the problem and meets the criteria/constraints?
- What are my personal strengths and weaknesses as it relates to the problem solving process?
- How did I/we do in our process of design? What went well? What could have gone better?
- After testing and reviewing the associated data, how can I/we improve the design to optimize results?

Learning Objectives/Discipline Standards of Practice

Learning Objectives:

- Identify and define products and scenarios as the study of science, technology, or engineering.
- Present and reflect upon critical developments in the human-designed world.
- Identify and classify products into the six categories of the designed world.
- Identify and explain the steps of the engineering design process.
- Apply the steps of the engineering design process to solve problems.
    - Example Problem: You have been collecting change everyday for the past year. The time has come that you want to find out how much money you have collected. Unfortunately, the bank only accepts coins that have been sorted and separated. Your goal will be to create a device that can sort handfuls of coins and separate them by type. You will be given a mix of quarters, nickels, and dimes that you will need to separate.
- Work collaboratively to brainstorm what they will need to know prior to the design and build phases of the design process.
    - Conduct research
    - Note down what they already know
- Engage in interviews and discussions with members of the target audience in order to ensure that all necessary prerequisite information is obtained and included in the design process.
- Develop multiple solutions to a given problem.
- Create an orthographic drawing for the final design.
- Select the best solution, explaining how it will work and how it meets the criteria and constraints.
- Reflect on their personal strengths and weaknesses as it relates to the problem solving process, as well as on their process of design.
- Engage in testing, data analysis, and a redesign of their solution, clearly explaining what improvements were made and why.
- Demonstrate proper safety procedures when using tools to assist in design.

Discipline Standards of Practice:

- Computing Systems
    - People interact with a wide variety of computing devices that collect, store, analyze, and act upon information in ways that can affect human capabilities both positively and negatively. The physical components (hardware) and instructions (software) that make up a computing system communicate and process information in digital form.
- Networks and the Internet
    - Computing devices typically do not operate in isolation. Networks connect computing devices to share information and resources and are an increasingly integral part of

computing. Networks and communication systems provide greater connectivity in the computing world.

- Impacts of Computing
    - Computing affects many aspects of the world in both positive and negative ways at local, national, and global levels. Individuals and communities influence computing through their behaviors and cultural and social interactions, and, in turn, computing influences new cultural practices.
- Data & Analysis
    - Computing systems exist to process data. The amount of digital data generated in the world is rapidly expanding, so the need to process data effectively is increasingly important. Data is collected and stored so that it can be analyzed to better understand the world and make more accurate predictions.
- Algorithms & Programming
    - An algorithm is a sequence of steps designed to accomplish a specific task. Algorithms are translated into programs, or code, to provide instructions for computing devices. Algorithms and programming control all computing systems, empowering people to communicate with the world in new ways and solve compelling problems.
- Engineering Design
    - People design for enjoyment and to solve problems, extend human capabilities, satisfy needs and wants, and improve the human condition. Engineering Design, a systematic approach to creating solutions to technological problems and finding ways to meet people's needs and desires, allows for the effective and efficient development of products and systems.
- Interaction of Technology and Humans
    - Societies influence technological development. Societies are characterized by common elements such as shared values, differentiated roles, and cultural norms, as well as by entities such as community institutions, organizations, and businesses. Interaction of Technology and Humans concerns the ways society drives the improvement and creation of new technologies, and how technologies both serve and change society.
- Nature of Technology
    - Human population, patterns and movement focus on the size, composition, distribution, and movement of human populations and how they are fundamental and active features on Earth's surface. This includes understanding that the expansion and redistribution of the human population affects patterns of settlement, environmental changes, and resource use. Patterns and movements of population also relate to physical phenomena including climate variability, landforms, and locations of various natural hazards and their effects on population size, composition, and distribution.
- Effects of Technology on the Natural World
    - Many of engineering and technology's impacts on society and the environment are widely regarded as desirable. However, other impacts are regarded as less desirable. Effects of Technology on the Natural World concerns the positive and negative ways that technologies affect the natural world.
- Ethics & Culture
    - Ethics and Culture concerns the profound effects that technologies have on people, how those effects can widen or narrow disparities, and the responsibility that people have for the societal consequences of their technological decisions.

Instructional Resources and Materials
Whole class resources have been identified with an asterisk.

Resources

- Engineering by Design (ITEEA)
- *Launch: Using Design Thinking to Boost Creativity and Bring Out the Maker in Every Student* by John Spencer and A.J. Juliani
- *The Innovator's Mindset: Empower Learning, Unleash Talent, and Lead a Culture of Creativity* by George Couros

Materials

- Access to basic hand tools and fabrication equipment.
    - Hot Glue Guns
    - X-Acto Knives
    - Hot Glue Gun & XActo Knife Rules/Procedures
- Building Materials for Design Challenges:
    - Cardboard
    - Felt
    - Rubber Bands
    - Plastic Cups
    - Construction Paper
    - Foam Core
    - Popsicle Sticks
    - Masking Tape
    - Glue
    - Straws
    - Markers
    - Colored Pencils
    - Paper Clips
    - Binder Clips
    - Foam
    - Building Blocks

Assessment Strategies
Assessment is designed to measure a student's mastery of a course standard and learning objective. Assessment can be used for both instructional purposes (formative assessment) and for evaluative purposes (summative assessment).

<u>Assessment Methods:</u>

- Students will complete approximately four (4) guided projects with individual self-reflection and notes to contribute to a group discussion.
- Students will also complete approximately two (2) projects that will allow them to demonstrate knowledge of creative problem solving in an independent manner with the assistance of notes, and student/teacher feedback.
- Students will complete a technical drawing using guidelines to demonstrate mental planning and communication before construction of a product begins.
- When a student completes a project, s/he will complete a critique sheet, reflecting on their work and answer thoughtful questions on their design process.

Revision Date: *December 2021*

- A rubric is outlined on the critique sheet, delineating the project parameters and expectations.

Course Specific Assessments Include:

- Cup Tower Design Challenge
- Paper Chain Challenge
- Lens Challenge
- Birdhouse Challenge
- Marble Maze Challenge
- Coin Sorter Challenge
- Locker Organizer Challenge
- Wallet Design Challenge

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